

Sub F1
44. (Currently Amended) An apparatus for interfacing a user with a computer providing a laparoscopic surgical simulation, ~~the apparatus, comprising:~~

~~a user object simulating at least a portion of a medical instrument used in a laparoscopic surgical procedure, said user object comprising a handle and an elongated member;~~

~~a gimbal mechanism receiving closed-loop five member linkage coupled to the user object and allowing the user object to be manipulated in first, second and third rotary degrees of freedom and in a first translational degree of freedom, the gimbal mechanism comprising a, the closed-loop five member linkage configured to provide enable the user object to move in the a first rotary degree of freedom, and a second rotary degree degrees of freedom, and in a translational degree of freedom; and~~

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~~a sensing system at least one sensor coupled to the gimbal mechanism closed-loop five member linkage and operative to detect manipulation a movement of the user object in at least one degree of freedom; and the first, second, and third rotational degrees of freedom and in the first translational degree of freedom, wherein said sensing system provides sensor input related to said manipulation in said first, second, and third rotational degrees of freedom and said first translation degree of freedom to said computer to control a virtual reality image in said laparoscopic surgical simulation displayed on a display device by said computer.~~

~~at least one actuator coupled to the closed-loop five member linkage and configured to output a feedback force, the feedback force responsive to the movement of the user object.~~

45. (Currently Amended) An apparatus according to claim 44, ~~further comprising a handle sensor coupled to the handle to detect manipulation of at least a portion of the handle, wherein the user object includes a grip portion and an elongated portion.~~

46. (Currently Amended) An apparatus according to claim 44 ~~45~~, wherein the handle comprises relatively pivotable portions grip portion further includes a first member and a second member, the first and second members movable relative to one another to simulate a cutting blade of a medical instrument.

47. (Currently Amended) An apparatus according to claim 46, further comprising a sensor transducer coupled to the handle grip portion of the user object to detect, the transducer responsive to a relative motion of the pivotable portions the first and second members.

48. (Currently Amended) An apparatus according to claim 44 45 wherein the handle comprises grip portion includes a finger wheel.

49. (Currently Amended) An apparatus according to claim 44 45, further comprising a barrier disposed between the grip portion and the closed-loop five member linkage between the handle and the gimbal mechanism.

50. (Currently Amended) An apparatus according to claim 44 45, further comprising a trocar disposed between the handle grip portion and the gimbal mechanism closed-loop five member linkage.

51 – 56 (Canceled)

57. (Currently Amended) An apparatus for interfacing a user with a computer providing a laparoscopic surgical simulation, the apparatus, comprising:

a user object simulating including a grip portion and an elongated portion, the user object being configured to represent at least a portion of a medical instrument used in a laparoscopic surgical procedure surgical instrument, said user object comprising a handle and an elongated member;

a gimbal mechanism closed-loop five member linkage coupled to receiving the user object, the closed-loop five member linkage configured to enable and allowing the user object to be manipulated move in first, and second and third rotary degrees of freedom and in a first translational degree of freedom, the gimbal mechanism comprising a five member linkage;

at least one sensor sensing system coupled to the gimbal mechanism closed-loop five member linkage and operative to detect manipulation a movement of the user object in the first, second, and third rotational degrees of freedom and in the first translational degree of freedom at

least one degree of freedom, the detection of the at least one sensor associated with the movement of the user object being input to a laparoscopic surgical simulation wherein said sensing system provides sensor input related to said manipulation in said first, second, and third rotational degrees of freedom and said first translation degree of freedom to said computer to control a virtual reality image in said laparoscopic surgical simulation displayed on a display device by said computer; and

an at least one actuator coupled to the gimbal mechanism closed-loop five member linkage and configured to output a feedback force, the feedback force being correlated with the laparoscopic surgical simulation wherein a capstan drum, cable and pulley transmit a force from said actuator to the user in one or more of the degrees of freedom, wherein the actuator outputs one or more forces associated with the simulation.

58. (Currently Amended) An apparatus according to claim 57, further comprising at least one capstan mechanism wherein the actuator is coupled to the at least one actuator and the gimbal mechanism closed-loop five member linkage through the cable and pulley to provide a force to the user in the first translational degree of freedom.

59. (Currently Amended) An apparatus according to claim 57, wherein said five member linkage is a closed-loop linkage and provides the first and second rotary degrees of freedom of the gimbal mechanism the at least one actuator includes a plurality of actuators, each actuator being associated with one of the first and second rotational degrees of freedom and the translational degree of freedom.

60 - 63 (Canceled)

64. (New) An apparatus according to claim 44, wherein the use object is representative of one of a laparoscopic instrument, an endoscopic instrument, a catheter, a hypodermic needle, a fiber optic bundle, a joystick, a screw driver, and a pool cue.

65. (New) An apparatus according to claim 44, wherein the detection of the at least one sensor associated with the movement of the user object is input to a virtual reality simulation.
66. (New) An apparatus according to claim 65, wherein the virtual reality simulation includes a medical procedure.
67. (New) An apparatus according to claim 65, wherein the feedback force is correlated with the virtual reality simulation.
68. (New) An apparatus according to claim 44, further comprising at least one capstan drive mechanism coupled to the at least one actuator and to the closed-loop five member linkage, the at least one capstan mechanism configured to facilitate a transmission of the feedback force from the at least one actuator to the closed-loop five member linkage.
69. (New) An apparatus according to claim 68, wherein the at least one capstan mechanism includes an assembly of a capstan drum, a one cable, and a pulley.
70. (New) An apparatus according to claim 44, wherein the at least one actuator includes a motor.
71. (New) An apparatus according to claim 44, wherein the at least one actuator includes a braking mechanism.
72. (New) An apparatus according to claim 57, wherein the grip portion further includes a first member and a second member movable relative to one another, configured to simulate a cutting blade in the laparoscopic surgical instrument.
73. (New) An apparatus according to claim 72, further comprising a transducer coupled to the grip portion, the transducer responsive to a relative motion of the first and second members.